AMENDMENTS

Amendment to the Claims

Please amend the claims as follows:

1. (Canceled)

2. (Previously presented) The method of claim 239 wherein X is fluorine.

3. (Previously presented) The method of claim 239 wherein X is sulfur.

4. (Previously presented) The method of claim 239 wherein X is chlorine.

5. (Previously presented) The method of claim 239 wherein said final coefficient of friction is about 0.3 or less.

6. (Previously presented) The method of claim 239 wherein said final coefficient of friction is about 0.2 or less.

7. (Previously presented) The method of claim 239 wherein said final coefficient of friction is about 0.1 or less.

8. (Previously presented) The method of claim 239 wherein said sufficient quantity comprises from about 10 atomic % to about 40 atomic % X in relation to chromium content.

9. (Previously presented) The method of claim 239 wherein said sufficient quantity comprises about 25 atomic % X in relation to chromium content.

10. (Original) The method of claim 2 wherein said sufficient quantity comprises from about 10 atomic % to about 40 atomic % X in relation to chromium content.

11. (Original) The method of claim 2 wherein said sufficient quantity comprises about 25 atomic % X in relation to chromium content.

12. (Original) The method of claim 3 wherein said sufficient quantity comprises from about 10 atomic % to about 40 atomic % X in relation to chromium content.

13. (Original) The method of claim 3 wherein said sufficient quantity comprises about 25 atomic % X in relation to chromium content.

14. (Original) The method of claim 4 wherein said sufficient quantity comprises from about 10 atomic % to about 40 atomic % X in relation to chromium content.

15. (Original) The method of claim 4 wherein said sufficient quantity comprises about 25 atomic % X in relation to chromium content.

16. (Previously presented) The method of claim 239 wherein said surface comprises an initial hardness and said conditions are effective to produce a final hardness that is greater than said initial hardness.

17. (Original) The method of claim 2 wherein said surface comprises an initial hardness and said conditions are effective to produce a final hardness that is greater than said initial hardness.

18. (Original) The method of claim 3 wherein said surface comprises an initial hardness and said conditions are effective to produce a final hardness that is greater than said initial hardness.

19. (Original) The method of claim 4 wherein said surface comprises an initial hardness and said conditions are effective to produce a final hardness that is greater than said initial hardness.

20. (Original) The method of claim 5 wherein said surface comprises an initial hardness and said conditions are effective to produce a final hardness that is greater than said initial hardness.

21. (Original) The method of claim 6 wherein said surface comprises an initial hardness and said conditions are effective to produce a final hardness that is greater than said initial hardness.

22. (Original) The method of claim 7 wherein said surface comprises an initial hardness and said conditions are effective to produce a final hardness that is greater than said initial hardness.

23. (Original) The method of claim 16 wherein said final hardness is about 15 GPa or more.

24. (Original) The method of claim 16 wherein said final hardness is about 20 GPa or more.

25. (Original) The method of claim 16 wherein said final hardness is about 25 GPa or more.

26. (Original) The method of claim 17 wherein said final hardness is about 15 GPa or more.

27. (Original) The method of claim 17 wherein said final hardness is about 20 GPa or more.

28. (Original) The method of claim 17 wherein said final hardness is about 25 GPa or more.

29. (Original) The method of claim 18 wherein said final hardness is about 15 GPa or more.

30. (Original) The method of claim 18 wherein said final hardness is about 20 GPa or more.

31. (Original) The method of claim 18 wherein said final hardness is about 25 GPa or more.

32. (Original) The method of claim 19 wherein said final hardness is about 15 GPa or more.

33. (Original) The method of claim 19 wherein said final hardness is about 20 GPa or more.

34. (Original) The method of claim 19 wherein said final hardness is about 25 GPa or more.

35. (Original) The method of claim 20 wherein said final hardness is about 15 GPa or more.

36. (Original) The method of claim 20 wherein said final hardness is about 20 GPa or more.

37. (Original) The method of claim 20 wherein said final hardness is about 25 GPa or more.

38. (Original) The method of claim 21 wherein said final hardness is about 15 GPa or more.

39. (Original) The method of claim 21 wherein said final hardness is about 20 GPa or more.

40. (Original) The method of claim 21 wherein said final hardness is about 25 GPa or more.

41. (Original) The method of claim 22 wherein said final hardness is about 15 GPa or more.

42. (Original) The method of claim 22 wherein said final hardness is about 20 GPa or more.

43. (Original) The method of claim 22 wherein said final hardness is about 25 GPa or more.

44. (Original) The method of claim 2 wherein said final coefficient of friction is about 0.3 or less.

45. (Original) The method of claim 2 wherein said final coefficient of friction is about 0.2 or less.

46. (Original) The method of claim 2 wherein said final coefficient of friction is about 0.1 or less.

47. (Original) The method of claim 2 wherein said sufficient quantity comprises from about 10 atomic % to about 40 atomic % X in relation to chromium content.

48. (Original) The method of claim 2 wherein said sufficient quantity comprises about 25 atomic % X in relation to chromium content.

49. (Original) The method of claim 29 wherein said sufficient quantity comprises from about 10 atomic % to about 40 atomic % X in relation to chromium content.

50. (Original) The method of claim 29 wherein said sufficient quantity comprises about 25 atomic % X in relation to chromium content.

51. (Original) The method of claim 30 wherein said sufficient quantity comprises from about 10 atomic % to about 40 atomic % substituent in relation to chromium content.

52. (Original) The method of claim 30 wherein said sufficient quantity comprises about 25 atomic % X in relation to chromium content.

53. (Original) The method of claim 31 wherein said sufficient quantity comprises from about 10 atomic % to about 40 atomic % X in relation to chromium content.

54. (Original) The method of claim 31 wherein said sufficient quantity comprises about 25 atomic % X in relation to chromium content.

55. (Original) The method of claim 44 wherein said surface comprises an initial hardness and said conditions are effective to produce a final hardness that is greater than said initial hardness.

56. (Original) The method of claim 45 wherein said surface comprises an initial hardness and said conditions are effective to produce a final hardness that is greater than said initial hardness.

57. (Original) The method of claim 46 wherein said surface comprises an initial hardness and said conditions are effective to produce a final hardness that is greater than said initial hardness.

58. (Original) The method of claim 55 wherein said final hardness is about 15 GPa or more.

59. (Original) The method of claim 55 wherein said final hardness is about 20 GPa or more.

60. (Original) The method of claim 55 wherein said final hardness is about 25 GPa or more.

61. (Original) The method of claim 56 wherein said final hardness is about 15 GPa or more.

62. (Original) The method of claim 56 wherein said final hardness is about 20 GPa or more.

63. (Original) The method of claim 56 wherein said final hardness is about 25 GPa or more.

64. (Original) The method of claim 57 wherein said final hardness is about 15 GPa or more.

65. (Original) The method of claim 57 wherein said final hardness is about 20 GPa or more.

66. (Original) The method of claim 57 wherein said final hardness is about 25 GPa or more.

67. (Original) The method of claim 3 wherein said final coefficient of friction is about 0.3 or less.

68. (Original) The method of claim 3 wherein said final coefficient of friction is about 0.2 or less.

69. (Original) The method of claim 3 wherein said final coefficient of friction is about 0.1 or less.

70. (Original) The method of claim 3 wherein said sufficient quantity comprises from about 10 atomic % to about 40 atomic % X in relation to chromium content.

71. (Original) The method of claim 3 wherein said sufficient quantity comprises about 25 atomic % X in relation to chromium content.

72. (Original) The method of claim 41 wherein said sufficient quantity comprises from about 10 atomic % to about 40 atomic % X in relation to chromium content.

73. (Original) The method of claim 41 wherein said sufficient quantity comprises about 25 atomic % X in relation to chromium content.

74. (Original) The method of claim 42 wherein said sufficient quantity comprises from about 10 atomic % to about 40 atomic % X in relation to chromium content.

75. (Original) The method of claim 42 wherein said sufficient quantity comprises about 25 atomic % X in relation to chromium content.

76. (Original) The method of claim 43 wherein said sufficient quantity comprises from about 10 atomic % to about 40 atomic % X in relation to chromium content.

77. (Original) The method of claim 43 wherein said sufficient quantity comprises about 25 atomic % X in relation to chromium content.

78. (Original) The method of claim 67 wherein said surface comprises an initial hardness and said conditions are effective to produce a final hardness that is greater than said initial hardness.

79. (Original) The method of claim 68 wherein said surface comprises an initial hardness and said conditions are effective to produce a final hardness that is greater than said initial hardness.

80. (Original) The method of claim 69 wherein said surface comprises an initial hardness and said conditions are effective to produce a final hardness that is greater than said initial hardness.

81. (Original) The method of claim 78 wherein said final hardness is about 15 GPa or more.

82. (Original) The method of claim 78 wherein said final hardness is about 20 GPa or more.

83. (Original) The method of claim 78 wherein said final hardness is about 25 GPa or more.

84. (Original) The method of claim 79 wherein said final hardness is about 15 GPa or more.

85. (Original) The method of claim 79 wherein said final hardness is about 20 GPa or more.

86. (Original) The method of claim 79 wherein said final hardness is about 25 GPa or more.

87. (Original) The method of claim 80 wherein said final hardness is about 15 GPa or more.

88. (Original) The method of claim 81 wherein said final hardness is about 20 GPa or more.

89. (Original) The method of claim 81 wherein said final hardness is about 25 GPa or more.

90. (Canceled)

91. (Previously presented) The method of claim 240 wherein said final coefficient of friction of said surface is about 0.3 or less.

92. (Previously presented) The method of claim 240 wherein said final coefficient of friction of said surface is about 0.2 or less.

93. (Previously presented) The method of claim 240 wherein said final coefficient of friction of said surface is about 0.1 or less.

94. (Previously presented) The method of claim 240 wherein said additive is selected from the group consisting of carbon monoxide, carbon dioxide, formic acid, methyl alcohol, ethyl alcohol, and acetone.

95. (Currently amended) The method of claim 240 wherein said lubricous outer surface comprises from about 10 atomic % to about 40 atomic % oxygen ~~substituent~~ in relation to chromium content.

96. (Currently amended) The method of claim 240 wherein said lubricous outer surface comprises about 25 atomic % oxygen ~~substituent~~ in relation to chromium content.

97. (Currently amended) The method of claim 91 wherein said lubricous outer surface comprises from about 10 atomic % to about 40 atomic % oxygen ~~substituent~~ in relation to chromium content.

98. (Currently amended) The method of claim 91 wherein said lubricous outer surface comprises about 25 atomic % oxygen ~~substituent~~ in relation to chromium content.

99. (Currently amended) The method of claim 92 wherein said lubricous outer surface comprises from about 10 atomic % to about 40 atomic % oxygen ~~substituent~~ in relation to chromium content.

100. (Currently amended) The method of claim 92 wherein said lubricous outer surface comprises about 25 atomic % oxygen ~~substituent~~ in relation to chromium content.

101. (Currently amended) The method of claim 93 wherein said lubricous outer surface comprises from about 10 atomic % to about 40 atomic % oxygen ~~substituent~~ in relation to chromium content.

102. (Currently amended) The method of claim 94 wherein said lubricous outer surface comprises about 25 atomic % oxygen ~~substituent~~ in relation to chromium content.

103. (Currently amended) The method of claim 94 wherein said lubricous outer surface comprises from about 10 atomic % to about 40 atomic % oxygen ~~substituent~~ in relation to chromium content.

104. (Currently amended) The method of claim 240 wherein said lubricous outer surface comprises about 25 atomic % oxygen ~~substituent~~ in relation to chromium content.

105. (Currently amended) The method of claim ~~90~~ 240 wherein said surface comprises an initial hardness and said conditions are effective to produce a final hardness that is greater than said initial hardness.

106. (Original) The method of claim 91 wherein said surface comprises an initial hardness and said conditions are effective to produce a final hardness that is greater than said initial hardness.

107. (Original) The method of claim 92 wherein said surface comprises an initial hardness and said conditions are effective to produce a final hardness that is greater than said initial hardness.

108. (Original) The method of claim 93 wherein said surface comprises an initial hardness and said conditions are effective to produce a final hardness that is greater than said initial hardness.

109. (Original) The method of claim 94 wherein said surface comprises an initial hardness and said conditions are effective to produce a final hardness that is greater than said initial hardness.

110. (Original) The method of claim 105 wherein said final hardness is about 15 GPa or more.

111. (Original) The method of claim 105 wherein said final hardness is about 20 GPa or more.

112. (Original) The method of claim 105 wherein said final hardness is about 25 GPa or more.

113. (Original) The method of claim 106 wherein said final hardness is about 15 GPa or more.

114. (Original) The method of claim 106 wherein said final hardness is about 20 GPa or more.

115. (Original) The method of claim 106 wherein said final hardness is about 25 GPa or more.

116. (Original) The method of claim 107 wherein said final hardness is about 15 GPa or more.

117. (Original) The method of claim 107 wherein said final hardness is about 20 GPa or more.

118. (Original) The method of claim 107 wherein said final hardness is about 25 GPa or more.

119. (Original) The method of claim 108 wherein said final hardness is about 15 GPa or more.

120. (Original) The method of claim 108 wherein said final hardness is about 20 GPa or more.

121. (Original) The method of claim 108 wherein said final hardness is about 25 GPa or more.

122. (Original) The method of claim 109 wherein said final hardness is about 15 GPa or more.

123. (Original) The method of claim 109 wherein said final hardness is about 20 GPa or more.

124. (Original) The method of claim 109 wherein said final hardness is about 25 GPa or more.

125. (Canceled)

126. (Previously presented) The method of claim 241 wherein said additive is selected from the group consisting of carbon monoxide, carbon dioxide, formic acid, methyl alcohol, ethyl alcohol, and acetone.

127. (Previously presented) The method of claim 241 wherein said additive is selected from the group consisting of carbon monoxide ions and carbon dioxide ions.

128. (Previously presented) The method of claim 241 wherein said additive is carbon monoxide ions.

129. (Previously presented) The method of claim 241 wherein said final hardness is about 15 GPa or more.

130. (Previously presented) The method of claim 241 wherein said final hardness is about 20 GPa or more.

131. (Previously presented) The method of claim 241 wherein said final hardness is about 25 GPa or more.

132. (Original) The method of claim 126 wherein said final hardness is about 15 GPa or more.

133. (Original) The method of claim 126 wherein said final hardness is about 20 GPa or more.

134. (Original) The method of claim 126 wherein said final hardness is about 25 GPa or more.

135. (Original) The method of claim 127 wherein said final hardness is about 15 GPa or more.

136. (Original) The method of claim 127 wherein said final hardness is about 20 GPa or more.

137. (Original) The method of claim 127 wherein said final hardness is about 25 GPa or more.

138. (Original) The method of claim 128 wherein said final hardness is about 15 GPa or more.

139. (Original) The method of claim 128 wherein said final hardness is about 20 GPa or more.

140. (Original) The method of claim 128 wherein said final hardness is about 25 GPa or more.

141. (Canceled)

142. (Previously presented) The method of claim 242 wherein said final coefficient of friction of said surface is about 0.3 or less.

143. (Previously presented) The method of claim 242 wherein said final coefficient of friction of said surface is about 0.2 or less.

144. (Previously presented) The method of claim 242 wherein said final coefficient of friction of said surface is about 0.1 or less.

145. (Previously presented) The method of claim 242 wherein said surface comprises from about 10 atomic % to about 40 atomic % oxygen in relation to chromium content.

146. (Previously presented) The method of claim 242 wherein said surface comprises about 25 atomic % oxygen in relation to chromium content.

147. (Previously presented) The method of claim 142 wherein said surface comprises from about 10 atomic % to about 40 atomic % oxygen in relation to chromium content.

148. (Previously presented) The method of claim 142 wherein said surface comprises about 25 atomic % oxygen in relation to chromium content.

149. (Previously presented) The method of claim 143 wherein said surface comprises from about 10 atomic % to about 40 atomic % oxygen in relation to chromium content.

150. (Previously presented) The method of claim 143 wherein said surface comprises about 25 atomic % oxygen in relation to chromium content.

151. (Previously presented) The method of claim 144 wherein said surface comprises from about 10 atomic % to about 40 atomic % oxygen in relation to chromium content.

152. (Previously presented) The method of claim 144 wherein said surface comprises about 25 atomic % oxygen in relation to chromium content.

153. (Previously presented) The method of claim 242 wherein said surface comprises an initial hardness and said conditions are effective to produce a final hardness that is greater than said initial hardness.

154. (Original) The method of claim 142 wherein said surface comprises an initial hardness and said conditions are effective to produce a final hardness that is greater than said initial hardness.

155. (Original) The method of claim 143 wherein said surface comprises an initial hardness and said conditions are effective to produce a final hardness that is greater than said initial hardness.

156. (Original) The method of claim 144 wherein said surface comprises an initial hardness and said conditions are effective to produce a final hardness that is greater than said initial hardness.

157. (Previously presented) The method of claim 242 wherein said final hardness is about 15 GPa or more.

158. (Previously presented) The method of claim 242 wherein said final hardness is about 20 GPa or more.

159. (Previously presented) The method of claim 242 wherein said final hardness is about 25 GPa or more.

160. (Original) The method of claim 142 wherein said final hardness is about15 GPa or more.

161. (Original) The method of claim 142 wherein said final hardness is about 20 GPa or more.

162. (Original) The method of claim 142 wherein said final hardness is about 25 GPa or more.

163. (Original) The method of claim 143 wherein said final hardness is about 15 GPa or more.

164. (Original) The method of claim 143 wherein said final hardness is about 20 GPa or more.

165. (Original) The method of claim 143 wherein said final hardness is about 25 GPa or more.

166. (Original) The method of claim 144 wherein said final hardness is about 15 GPa or more.

167. (Original) The method of claim 144 wherein said final hardness is about 20 GPa or more.

168. (Original) The method of claim 144 wherein said final hardness is about 25 GPa or more.

Claims 169-211 (Canceled)

212. (Previously presented) A method of forming a lubricious chromium coating comprising:

providing a substrate selected from the group consisting of a chromium coating and a chromium alloy, said substrate comprising a surface comprising substrate chromium atoms, said surface having an initial hardness and an initial coefficient of friction in an unlubricated condition against a steel counterface;

means for reducing said initial coefficient of friction and for increasing said initial hardness.

Claims 213-216 (Canceled)

217. (Previously presented) A method of forming a hard chromium coating comprising:

providing a chromium coating having an initial hardness; and

means for increasing said initial hardness.

239. (Previously presented) A method of forming a lubricious outer surface comprising chromium, said method comprising:

providing a substrate selected from the group consisting of a chromium coating and a chromium alloy, said substrate comprising a surface comprising substrate chromium atoms, said surface having an initial coefficient of friction in an unlubricated condition against a steel counterface; and

treating said substrate with an additive comprising an element X under conditions effective to react X with said substrate chromium atoms, producing a mixture adjacent to said lubricious outer surface, said mixture comprising molecules of said substrate and chromium-X molecules comprising said substrate chromium atoms, wherein said lubricious outer surface comprises a sufficient quantity of said chromium-X molecules to produce a final coefficient of friction in an unlubricated condition against a steel counterface that is less than said initial coefficient of friction of said surface,

said additive being selected from the group consisting of

substituted or unsubstituted metal carbonyls comprising a metal selected from the group consisting of tungsten, molybdenum, chromium, iron, and nickel, wherein said substituted carbonyls comprise an oxygen of the carbonyl substituted by an element selected from the group consisting of X; and

compounds having the general formula

$$H_nC_mX_o$$

wherein

n is from about 0 to about 6;

m is from about 1 to about 2;

o is from about 1 to about 2; and,

X is selected from the group consisting of fluorine, oxygen, sulfur, and chlorine.

240. (Previously presented) A method of forming a lubricious outer surface comprising chromium, said method comprising:

providing a substrate selected from the group consisting of a chromium coating and a chromium alloy, said substrate comprising a surface comprising substrate chromium atoms, said surface having an initial coefficient of friction in an unlubricated condition against a steel counterface;

treating said surface with an additive comprising oxygen under conditions effective to produce a mixture adjacent to said lubricious outer surface, said mixture comprising substrate molecules and chromium-oxide molecules comprising said substrate chromium atoms, said lubricious outer surface consisting essentially of chromium oxide molecules comprising said substrate chromium atoms;

wherein said lubricous outer surface has a final coefficient of friction in an unlubricated condition against a steel counterface that is less than said initial coefficient of friction.

241. (Previously presented) A method of forming a hard surface comprising chromium, said method comprising:

providing a substrate selected from the group consisting of a chromium coating and a chromium alloy comprising substrate chromium atoms, said substrate comprising a surface having an initial hardness;

treating said surface with an additive comprising an element selected from the group consisting of oxygen, carbon, and a combination thereof under conditions effective to produce a final surface having a final hardness greater than said initial hardness, said final surface comprising a mixture adjacent to an outer surface, said mixture comprising substrate molecules and molecules selected from the group consisting of chromium oxide, chromium carbide, and a combination thereof, wherein said chromium consists essentially of said substrate chromium atoms.

242. (Previously presented) A method for making a medical implant comprising:

providing a component of a medical implant comprising a substrate comprising a surface comprising substrate chromium atoms, said surface having an initial coefficient of friction in an unlubricated condition against a steel counterface;

treating said surface with an additive comprising oxygen under conditions effective to produce a mixture adjacent to a lubricious outer surface comprising substrate molecules and chromium-oxide molecules consisting essentially of said substrate chromium atoms, said surface having a final coefficient of friction in an unlubricated condition against a steel counterface that is less than said initial coefficient of friction.

243. (Previously presented) A method of forming a chromium alloy comprising a lubricious outer surface, said method comprising:

providing a chromium alloy substrate, said substrate comprising a surface comprising substrate chromium atoms, said surface having an initial

hardness and an initial coefficient of friction in an unlubricated condition against a steel counterface;

means for reducing said initial coefficient of friction and for increasing said initial hardness.